General Discussion

Chairpersons : Watanabe, S. (Japan), Hoffman, D. (ACIAR), Ohkubo, T. (Japan), Jalaludin, S. (Malaysia)

Chairman : Watanabe, S. (Japan) : The four following topics will be taken up in the general discussion : 1. How to enhance the utilization of crop residues and agricultural by-products ; 2. How to overcome the low productivity of natural grasslands and related resources ; 3. How to develop packages of technology applicable to smallholders in integrated farming systems of rural areas and how to transfer new technology to the farmers ; 4. The role of the international organizations in the promotion of sustained productivity.

Chairman : Hoffman, D. (ACIAR) : It appears that the utilization of residues and by-products varies with the countries due to the differences in the availability of resources. For example Malaysia with its large amount of plantation crops can utilize such resources unlike Brazil where there is a quality shortage associated with the climatic conditions. Therefore, research priority should be directed to the evaluation of feed resources available in the respective countries and their subsequent utilization. Three aspects could be considered as follows : 1. How to increase the availability of crop by-products. In this regard, the relations with plant breeders could be enhanced. However the breeding efforts aim at developing resistance against pests and the silica content of the crops tends to increase which may result in the decrease of digestibility of the by-products. 2. The digestibility of the residues could be increased by various methods. I must admit that I am somehow skeptical about the degradation of roughages by biological methods since the metabolic pathways for yeasts and fungi may be similar and fewer nutrients may eventually be available to the animals. 3. The efficiency of rumen digestion could be increased. However, as mentioned by Dr. Cheng, since the rumen is a very efficient organ it may be difficult to further enhance the efficiency. There is also an other approach, namely providing acid digestion of waste products out of the rumen. The volatile fatty acids thus produced could be fed to yeasts (pedicle type) hanging on screens which would be given to the animals after drying. This method has been used effectively in Australia for several years. The discussions could be centered on the following aspects : how to solve the country problems, how could the quality of the products be enhanced, how could the digestibility be enhanced by either chemical treatments or bioengineering and how to improve the efficiency of the rumen microorganisms.

Cheng, K.J. (Canada) : In low quality feeds, the lower the quality of feed given to animals, the higher the destruction of the protein. It is thus important to increase the supply of protein (by-pass protein) to meet the protein requirements of the ruminants. This could also be achieved by administering processed feed resulting in the by-passing of protein.

Pradhan, K. (India) : The proteins present in the residues and by-products utilized as feed are characterized by a low content and quality and are not always digested. However it is important that a sufficient amount of protein or nitrogen remain in the rumen to secure the growth of the ruminal flora. I would like to add that efforts should be made to continuously expand the feed resources by introducing new by-products/wastes or residues from forest, sea, agricultural or industrial origin along with promoting research on their chemical composition, nutrient contents, presence of toxins, etc. and further improving the quality for animal use. The collection, storage and processing of the products on an economic basis should also be pursued.

Kosaka, K. (Japan) : Concerning the hydrolysis of bagasse presented by Dr. Lopes, I would appreciate additional details about the following : the hydrolysis method (equipment,

conditions, etc.) ; effects of hydrolysis on feed intake, digestibility or performance of cattle and ; potential of this processing method in taking account of the degree of change in the nutritive value and the processing cost.

Lopes, H.O.S. (Brazil) : Concerning the hydrolysis method, steam pressure is most suitable. A large amount of literature is available on the effects of hydrolysis on feed intake, digestibility and performance of cattle and I would like to hand over these references to Dr. Kosaka later on. The processing method has been used mainly by sugar and alcohol enterprises very successfully in Brazil. Therefore bagasse can be used effectively as animal feed since the sugarcane and alcohol factories produce large amounts of bagasse. Moreover the cost of processing is low.

Tajuddin, Z.A. (Malaysia) : The technical feasibility of using the fibrous agro-industrial by-products has shown considerable progress even though refinements are required. There is a need to look into problems of collection, storage and processing of these materials so that operations can be scaled up and commercialized. This problem needs to be addressed to very seriously. Based on the presentations at this symposium, it appears that only China has scaled up the operations and in the other countries progress has not been appreciable. In this regard, I believe that the involvement of agricultural engineers would be highly desirable.

Lopes, H.O.S. (Brazil) : I would like to make a comment. It is difficult to explain why the agricultural by-products are not fully utilized in Brazil or other countries in spite of the availability of methods of processing. Indeed I believe that sustainable and economical crop-livestock systems are only possible if by-products are effectively utilized.

Chairman : Hoffman, D. (ACIAR) : To address these problems, socio-economic conditions that are site-specific must be considered. In this regard, it is interesting to mention that FAO RAPA commissionned an economist to evaluate the utilization and treatment of straw. The results of the survey showed that the method was associated with good cost return investment. I also believe that the government policies should be changed to tackle these problems.

Haryanto, B. (Indonesia) : Regarding the enhancement of the utilization of crop residues and agro-industrial by-products, the small landholders in Indonesia are not used to store these by-products for animal feed. Therefore, I believe that techniques that are more applicable for the preservation of by-products should be developed at the smallholder level.

Pradhan, K. (India) : In working with by-products/wastes for use as animal feed, it is necessary for animal nutritionists, biochemists, physiologists and animal health specialists to collaborate for evaluating the quality of the products, including the presence of toxins or anti-metabolites as well as the efficiency of utilization by various classes of livestock at different physiological stages to avoid accidents.

Argañosa, A.S. (Philippines) : The farmers in the provinces heavily affected by the recent volcanic eruption of Mt. Pinatubo are now making use of the technologies developed to utilize crop residues such as urea-molasses mineral blocks, rice straw, etc. However the adoption of these techniques is being promoted by the government and not on the initiative of the farmers, which suggests that socio-economic factors play an important role in the utilization of crop residues. Three months ago I had the opportunity of interviewing farmers involved in the buffalo breeding project. It appeared that cost prevented the farmers from adopting certain techniques, for example the use of concentrates.

Chairman : Hoffman, D. (ACIAR) : I agree and I believe that it is necessary to create a cash economy for example by the development of a cooperative system. I would like to make another comment. Indeed I find it difficult to understand how it is possible to select bacteria and put them in an animal and expect that they will not compete with

other microorganisms and eventually be eliminated, when considering the dynamics, rapid multiplication rate of bacteria and genetic evolution in the gut over the time. I wonder if Dr. Cheng would answer my question.

Cheng, K.J. (Canada) : Many experiments (unpublished data) involving the oral inoculation of collected microbial stock cultures into newborn lambs suggested that the rumen bacteria, in particular the cellulolytic bacteria selected for inoculation are fairly stable in the rumen in spite of the rapid multiplication rate of rumen bacteria. In this regard, we selected *Butyrivibrio fibrisolvens* due to its firm attachment to the food particles.

Chairman : Hoffman, D. (ACIAR) : I would like to briefly conclude the discussion. Some technology is available for the processing of agricultural by-products but these resources are not being effectively utilized by the farmers. Various problems must be addressed including the collection and storage of these resources as well as socio-economic conditions and close collaboration with agricultural engineers, suggesting that a multi-disciplinary approach might be effective. Since each country has a unique set of resources and climatic conditions, site-specific strategies should be adopted. It is important to create a cash economy to enable the farmers to purchase necessary inputs to process the resources. Finally, there is also a potential for the application of genetic engineering. However, many problems remain to be solved before such methods can be utilized practically.

Chairman : Ohkubo, T. (Japan) : I would like to discuss in greater detail various aspects relating to the alleviation of the low productivity of natural grasslands and related resources. Three main themes could be considered : 1. Optimum utilization for grazing of natural grasslands ; 2. Introduction of other grass or legume species into the grasslands and ; 3. Supplementation in the dry season or dry areas. Could I ask Dr. Meng to make a comment since China has vast areas of grasslands.

Meng, Q. (China) : In China three systems are applied for raising animals. The use of grasslands is associated with low animal production due to the low productivity of the grasslands and overgrazing. Small landholders use crop residues with supplements to raise animals. Supplementation consists primarily of urea followed by by-pass protein made of soybean meal as well as by-pass starch. Urea for supplementation and treatment of straw is expensive due to the limited production of urea in China and the high retail cost. There are also intensive systems for feeding ruminants mainly for export or use in hotels. As a rule the conditions for feeding ruminants are not satisfactory in China due to technological problems. It is necessary to develop low-cost methods of treatment and enact policies to encourage ruminant feeding.

Pradhan, K. (India) : In India the use of grasslands for livestock production is not being promoted due to overgrazing. Also no agency is responsible for the improvement of grasslands since the land is public and belongs to the government. Moreover the area under grassland is decreasing since the land is being utilized for more profitable purposes. There is a need for a strong political will to enact policies required for the improvement of grasslands. Grassland improvement under forest canopy is not successful either. Presently, wasteland utilization for growing grasses or trees has a greater potential compared with the existing natural grasslands for livestock in India and presumably other developing countries in the tropics.

Chairman : Ohkubo, T. (Japan) : It appears that such a situation occurs in Africa as mentioned by Dr. Watanabe.

Chairman : Watanabe, S. (Japan) : The rapid growth of the population is leading to the degradation of the eco-systems. In Africa, there are nomads, agro-pastoralists and sedentary farmers. Only natural grasslands are utilized. Presently due to the increase of the population, agro-pastoralists and nomads would like to become sedentary and they tend to move to the sub-humid zone. As a result they cultivate crops in lands

which were formerly used as grasslands with scattered patches of cultivated crops and there is a concentration of livestock in these areas, which leads to land degradation. ILCA is promoting the creation of fodder banks to be opened to the livestock at the end of the dry season and it is considered that this system is highly beneficial to resource-poor farmers in these areas.

Chairman : Ohkubo, T. (Japan) : I would like to ask Dr. Pradhan if there are such fodder banks in India.

Pradhan, K. (India) : We tried to implement this system a few years ago but did not succeed due to the lack of land available and the large population of cattle. This system could be implemented within the framework of the wasteland utilization program under local administrative control.

Chairman : Ohkubo, T. (Japan) : We will now discuss various aspects relating to the introduction of other grass or legume species into grasslands.

Argañosa, A.S. (Philippines) : The introduction of legume species may be the most practical measure in the Philippines to utilize natural grasslands since the introduction of improved species of pasture crops may be expensive due to the low soil fertility and high acidity that would require the use of fertilizers and lime.

Chairman : Ohkubo, T. (Japan) : May I ask Dr. Maeno to comment on these particular aspects.

Maeno, N. (Japan) : Native pastures in the tropics are the main source of feed resources and to improve the low quality, legumes should be introduced. A suitable alternative is the creation of fodder or protein banks, particularly at the first stage of introduction of legumes as high investment would not be necessary. Promising legumes are site-specific and selection would be important.

Lopes, H.O.S. (Brazil) : We have made several attempts to introduce legumes into the native pastures of the Brazilian savanna. However these efforts have not been successful because the soils in this region are characterized by a low fertility and phosphorus content as well as by a high acidity and high aluminum saturation and their amendment would require costly inputs (fertilizers). Moreover there is a poor persistence of the legumes in the grass stands. EMBRAPA has given high priority to the legume-based pastures and research is being carried out jointly with CIAT. Recently good results have been obtained. Regarding protein banks, the use of *Leucaena* species is not suitable and not economical in the Brazilian savanna due to their susceptibility to the soil characteristics mentioned above. Roots do not go deep enough and leaves often fall during the dry season. Presently crosses with varieties better adapted to the soil conditions are being made. In Brazil mimosine toxicity does not occur. Regarding the utilization of native pastures, there are vast areas available. However dry season supplementation using by-pass protein which is the most efficient method is not popular among the farmers in Brazil due to complex socio-economic reasons.

Chairman : Ohkubo, T. (Japan) : To conclude, I would like to emphasize the three following aspects : 1. It is necessary to make accurate measurements to estimate seasonal or yearly variations of herbage productivity and control of grazing rate. In this regard, studies on modeling approach or remote sensing to estimate grassland productivity so as to increase or decrease the grazing capacity should be carried out ; 2. For the improvement of natural grasslands, legume-based pastures are important. Also species of legumes best adapted to the local conditions should be identified and used and 3. Regarding supplementation, the possibility to supply carbohydrate (molasses) or protein resources must be evaluated. Also the possibility of improvement within the rumen through biotechnology to enhance the digestibility of native grasses should be considered, namely the possibility of changing the DNA of some bacteria.

Cheng, K.J. (Canada) : Canadian efforts to improve the deposition of essential amino acids

within the rumen microbial cells through genetic manipulation to provide essential amino acids to ruminant animals have been unsuccessful ut to now.

Tsuda, T. (Japan) : Is it possible to improve the digestibility of rice, barley or wheat straws through breeding or to increase their protein content and decrease their lignin content?

Chairman : Ohkubo, T. (Japan) : It would be difficult to improve such by-products to reduce the lignin content or increase the protein content since plant breeders are mainly interested in increasing the protein content of grain and increase the lignin content to enhance the resistance of the plant to the wind. However, genetic techniques could be applied because the content of protein and nitrogen as well as the digestibility of stem varies with the grass species. For example, the digestibility of the stem of sorghum is high unlike that of *Panicum* and *Paspalum*.

Tsuda, T. (Japan) : The plant breeders usually aim at increasing the grain yield. I wish they would also focus their attention on the improvement of the nutritive value of straw as animal feed so as to obtain two main products from one plant species.

Chairman : Watanabe, S. (Japan) : During a conference held in 1987, ILCA suggested that a certain equilibrium between grain and plant body should be attained.

Chairman : Jalaludin, S. (Malaysia) : The third topic of the general discussion refers to the development of technological packages for the smallholders in the tropics. It must be recognized that although significant advances have been made toward the development of new technologies in animal production in the tropics, their transfer to the farmers has not always been successful or has been incomplete. We should focus on a few major issues, namely the issues related to integrated farming systems, impact of livestock on the environment, socio-economic factors of the communities, production cost and investment, incentives to promote farming for animal production at the smallholder level. It is indeed critical that the technological packages should propel the growth of the livestock sector among smallholders. In the tropics, in particular in Southeast Asia, the ruminant sub-sector is an integral component of the farming systems of smallholders. The transfer of new technology is difficult because the level of education of the farmers is comparatively low. Production systems which are tradition-based and at the subsistence level are characterized by low input and low output and changes cannot be effected readily because the investment is limited. However some measures could be adopted to support the systems and make them more viable, profitable and beneficial to the farmers. Since the farmers cannot cover the cost of inputs, they need a form of assistance.

Pradhan, K. (India) : Incentives and inputs on the part of the government or other agencies are certainly important. However I believe that for the transfer of technology, it is necessary to develop confidence in the mind of the farmers to promote their acceptability and subsequent adoption of the measures proposed. In India, in the case of crop agriculture, such a system was found to be very effective at the time of the Green Revolution. Government officials, representatives from fertilizer, pesticides and seed companies went to the villages and set up demonstration plots to convince the farmers that the practices recommended were sound and profitable. On the other hand no agency is in charge of livestock agriculture in India and there is no extension network to promote the adoption of technological packages. Also during the Green Revolution, inputs originated from the government agencies as well as from the private sector.

Chairman : Jalaludin, S. (Malaysia) : I agree with Dr. Pradhan. Sometimes the technology that is recommended can not be applied. For example, when the use of *Leucaena* for feeding cattle to increase the yield is being advocated, it is obvious that *Leucaena* must be grown on the farm. The introduction of technological packages must be compatible with the environmental conditions to maximize the use of available resources, both feed and cattle. Technology is usually site-specific since feed and genetic resources

differ with the regions.

Cheng, K.J. (Canada) : When ammonia or urea treatment of feed is being recommended, ammonia toxicity may occur if animals are fed low-quality feed with excess ammonia or urea due to the increase of the rumen pH, which facilitates the diffusion of ammonia into the animal tissues. Toxicity can be prevented by adding concentrates to decrease the rumen pH.

Pradhan, K. (India) : The level of urea or ammonia added to treat straw (wheat/paddy) does not usually exceed 4%. About 70% of this amount is eliminated and the remaining 30% acts as a hydrolytic agent at high pH. Such a level has no adverse effects on the animals as demonstrated through a large number of studies carried out over a long period of time and may even help the digestion.

Lopes, H.O.S. (Brazil) : Urea is being largely used in the mineral mixtures given to grazing cattle in Brazil with very good results. The ingestion level is too low to cause toxicity to the animals and the use of urea mineral mixtures has enabled to reduce substantially dry season losses of grazing cattle on Brazilian Cerrados at a low cost.

Chairman : Watanabe, S. (Japan) : We are now reaching the last part of the general discussion and we will briefly consider the role of the international organizations in the promotion of sustained production of feed and livestock. In this regard I received a question from Dr. Ku Vera who asked the following : Is the improvement of the level of animal production in sub-Saharan Africa resulting from the research work carried out at ILCA being reflected in higher income and improvement of the nutritional status of smallholders? This is indeed an important question. As a whole the impact of the research outcome is minimal due to the unfavourable socio-economic conditions of these communities who are often risk-averse and the low development of the infrastructure for extension. ILCA is now adopting a farming systems approach whereby the farmers are being consulted prior to the development of technological packages, which may thus be very effective at the time of their application. I believe that the impact of ILCA on the NARS is very significant since manpower and research facilities have been up-graded and strengthened. Also the impact on the decisions of policy makers has been considerable. I also received a question from Dr. Katsumata who asped why ILCA is not carrying out research on nomadic people. The reason is that although ILCA is fully aware of the importance of this problem, such a line of research is not possible presently due to the limitation of both funds and manpower. To conclude, on behalf of the four chairpersons, I believe that the outcome of the symposium is useful since a large amount of information and a wide range of opinions were exchanged and friendship among researchers from various continents was promoted. The results and conclusions reached during the symposium should be implemented through practical realizations and in this regard the role of government and non-government organizations as well as scientists will be important to promote cooperation programs. However I believe that the real agents for the implementation of the recommendations of the symposium are the young scientists gathered here. In particular I would like to ask to the young Japanese researchers to promote upstream research and basic research adapted to the needs of the developing countries.